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COAL-MINE EXPLOSIONS AND FIRES IN THE UNITED STATES DURING THE FISCAL YEAR ENDED JUNE 30, 1935

BY

D. HARRINGTON AND W. J. FENE

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COAL-MINE EXPLOSIONS AND FIRES IN THE UNITED STATES DURING THE FISCAL YEAR ENDED JUNE 30, 1935[1]

By D. Harrington[2] and W. J. Fene[3]

INTRODUCTION

The experience of the past 2 years has demonstrated clearly that mine explosions with heavy loss of life can be prevented. The investigations of the Safety Division of the United States Bureau of Mines disclose that during the fiscal year 1934 there were only 28 deaths from mine explosions in the United States, and during the fiscal year 1935 there were 54 deaths, a very favorable reduction when compared with an average death toll of 265 from this cause during the 20-year period prior to 1929. Although the frequency of occurrence of explosions has not decreased greatly during the past 7 years, there has been a marked decrease in severity, indicating that the coal-mining industry is taking more effective precautions to prevent the spread of explosions. A number of large coal-producing States, which in past years have experienced numerous disastrous explosions, have been free from such disasters for continuous periods of as much as 5 years or even longer.

A study of several hundred mine explosions occurring in the United States during the past 10 years or more indicates that the factors mainly responsible for these explosions are inadequate or defective ventilation and disregard of the hazards from explosive gas. Both of these factors are subject to control, and if controlled it is safe to say that deaths from explosions would be reduced to a negligible number as relatively few explosions are now initiated by dust.

SUMMARY OF MINE EXPLOSIONS BY STATES

Table 1 shows the results of studies of 23 explosions in 8 States, with a total of 54 deaths, during the fiscal year ended June 30, 1935; this tabulation gives data on all explosions in mines in the United States that were called to the attention of the Safety Division of the U.S. Bureau of Mines

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during the fiscal year. The 23 ignitions occurring during the year are fewer than for the previous fiscal year, when 26 ignitions occurred; however, the number of deaths in 1935 was nearly twice as many - 54 compared with 28 during 1934 - indicating that there may have been some "let-down" in vigilance in safeguarding our coal operations in the past fiscal year; it certainly is to be hoped that the present fiscal year does not have the unhappy record of virtually doubling the deaths from explosions, as was the case in the fiscal year just ended compared with the previous fiscal year.

The States reporting the greatest number of deaths from explosions were: Pennsylvania, 24 (18 in anthracite mines); Virginia, 18; West Virginia, 5; Oklahoma and Wyoming, 3 each; and Kentucky, 1. Pennsylvania also led in number of ignitions with 11 (8 in anthracite mines); West Virginia was next with 4; Oklahoma and Virginia had 2 each; Alabama, Kentucky, Wisconsin (metal mine), and Wyoming had 1 each.

Two major explosions occurred during the fiscal year; one was in an anthracite mine and resulted in 13 deaths and one in a bituminous mine, with 17 deaths. During the previous fiscal year there was but 1 major explosion, with 7 deaths, and the year before that there were 3 major explosions, with 91 deaths.

Twenty-nine persons were killed during the past fiscal year in explosions caused by electricity compared with an average of 19 deaths per year for the preceding 3 years. There were 10 electrical ignitions during each of the last 2 years; however, a larger number of deaths per ignition was recorded in the past fiscal year.

West Virginia had the greatest number of electrical ignitions - 3, with 4 fatalities; Virginia had 2, with 18 fatalities; Pennsylvania, 2, with 3 fatalities; Wyoming, 1, with 3 fatalities; Kentucky, 1, with 1 fatality; and Alabama, 1, which resulted in 4 injuries but no fatalities.

Nine ignitions were caused by open lights or matches (5 of which were in anthracite mines) compared with 9 in 1934 and an average of 10 during the previous 6 fiscal years. Six deaths resulted from explosions caused by open lights and matches last year compared with an average of 33 during the previous 6 fiscal years. Ignitions by open lights and matches were distributed as follows: Pennsylvania, 5, with 2 fatalities; Oklahoma, 2, with 3 fatalities; West Virginia, 1, with 1 fatality; and Wisconsin (metal mine), 1, with no fatalities. Fewer deaths have been caused by open lights and matches during the past 2 years than in any year in the history of coal mining in the United States; this record probably is due to the fact that most of the mines of the United States which are heavy producers of explosive gas are now equipped with electric cap lamps.

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TABLE 1. - Summary of mine explosions by States, July 1, 1934, to June 30, 1935

State	Lights				Fatalities by ignition causes									
	Open	Closed	Unknown or no lights	Total mine explosions	Electricity		Open lights or smoking		Explosives		Unknown		Total	
					Deaths	Ignitions	Deaths	Ignitions	Deaths	Ignitions	Deaths	Ignitions	Deaths	Ignitions
Alabama	-	1	-	1	-	1	-	-	-	-	-	-	-	1
Kentucky	1	-	-	1	1	1	-	-	-	-	-	-	1	1
Oklahoma	1	1	-	2	-	-	3	2	-	-	-	-	3	2
Pennsylvania	3	8	-	1/ 11	3	2	2	5	3	2	16	2	24	11
Virginia	-	2	-	2	18	2	-	-	-	-	-	-	18	2
West Virginia	-	4	-	4	4	3	1	1	-	-	-	-	5	4
Wisconsin	2/ 1	-	-	2/ 1	-	-	-	2/ 1	-	-	-	-	-	2/ 1
Wyoming	-	1	-	1	3	1	-	-	-	-	-	-	3	1
Total, 1935	6	17	-	23	29	10	6	9	3	2	16	2	54	23
Total, 1934	9	14	3	26	21	10	2	9	2	3	3	4	28	26
Total, 1933	7	14	1	22	25	8	63	8	29	4	5	2	122	22
Total, 1932	2/ 15	2/ 15	2/ 4	2/ 34	11	10	33	15	42	5	1	3	87	33
Total, 1931	12	15	-	26	143	9	56	11	18	6	-	-	217	26
Total, 1930	8	25	1	34	154	18	21	8	24	6	-	2	199	34
Total, 1929	18	19	1	38	93	18	14	11	26	8	6	1	139	38

1/ 7 of these explosions were in anthracite mines.
2/ Ignition of methane in metal mine.

Note. - Explosions are recorded by fiscal years, and totals are for the United States.

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Two explosions with 3 fatalities originated from explosives during the past fiscal year compared with 3 explosions and 2 deaths from this cause during the fiscal year 1934 and an average of 10 explosions and 47 deaths for the past 6 years; this is also a new low record for explosions caused by explosives - one to be commended, as explosions from the use or rather the misuse of explosives are caused very easily. Both of these explosions occurred in Pennsylvania; one in an anthracite mine was caused by a mud-cap shot, and one in a bituminous mine was thought to have been caused by the accidental ignition of the explosives while being handled.

Two explosions in which the cause of ignition was not ascertained definitely occurred in 2 Pennsylvania anthracite mines, one resulting in 13 deaths and the other in 3 deaths. The one killing 13 is believed to have been caused by blasting; if this explosion is assessed against blasting the death record from such explosions would still be lower than for several years past with the exception of the fiscal year 1933-34, which had a remarkably low death rate from this cause.

RECORD OF EXPLOSIONS BY STATES

Table 2 records explosions during the past 7 fiscal years by States. During the 7-year period 202 ignitions caused 846 deaths, a yearly average of 28.86 ignitions and 120.86 deaths. The table lists only the explosions with which the Safety Division had contact; nevertheless it probably includes at least 98 percent of the explosions in the United States in which there was loss of life. The number of both ignitions and deaths during the past year was considerably less than the average for the 7-year period; there were also 3 fewer ignitions and 26 more deaths (23 ignitions and 54 deaths) than in the previous year (26 ignitions and 28 deaths). For the 7-year period (July 1, 1928 to June 30, 1935) Pennsylvania heads the list in total number of ignitions (61) and deaths (165); Oklahoma with but 10 ignitions ranked second in number of deaths (123), with no ignitions during 2 years of the period. It is of interest to note that during the 7 years Maryland, Wisconsin, Kansas, and Wyoming had 1 ignition each with a total of 6 deaths; that Tennessee had 3 ignitions without a fatality; and that Ohio had no ignitions in 4 years and Utah none in 5 years. The total average number of deaths per ignition is 4.21, the various States ranging from none to 11.50 deaths per ignition. No deaths resulted from 7 of the 23 explosions during the last year. The following coal-mining States and Territories are not listed in table 2 as having had any explosion during the past 7 fiscal years: Alaska, Arkansas, Iowa, Michigan, Missouri, Montana, North Dakota, and Texas.

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TABLE 2. - Record of explosions by States during last 7 fiscal years

State	1929		1930		1931		1932		1933		1934		1935		Total 7 years		Average per year		Average deaths per ignition
	Deaths	Ignitions	Deaths	Ignitions	Deaths	Ignitions	Deaths	Ignitions	Deaths	Ignitions	Deaths	Ignitions	Deaths	Ignitions	Deaths	Ignitions	Deaths	Ignitions	
Alabama	13	7	8	4	-	2	4	5	-	-	2	2	-	1	27	21	3.86	3.00	1.29
California	-	1	7	2	12	1	-	1	-	1	-	-	-	-	19	6	2.71	.87	3.17
Colorado	-	-	-	1	-	-	4	3	1	1	-	-	-	-	5	5	.71	.71	1.00
Illinois	-	3	10	2	2	1	3	3	54	1	-	-	-	-	69	10	9.86	1.43	6.90
Indiana	-	-	-	-	28	1	-	-	4	2	-	-	-	-	32	3	4.57	.43	10.66
Kansas	2	1	-	-	-	-	-	-	-	-	-	-	-	-	2	1	.29	.28	2.00
Kentucky	11	3	16	1	-	-	3	1	26	2	-	1	1	1	57	9	8.14	.87	6.33
Maryland	-	-	-	-	-	-	1	1	-	-	-	-	-	-	1	1	.14	.14	1.00
New Mexico	-	-	-	-	8	3	-	-	14	1	-	-	-	-	22	4	3.14	3.14	5.50
Ohio	3	3	1	2	88	3	-	-	-	-	-	-	-	-	92	8	13.14	1.14	11.50
Oklahoma	1	1	71	4	45	2	-	-	3	2	-	-	3	2	123	11	17.57	1.57	11.18
Pennsylvania	70	9	16	8	23	7	7	6	9	6	16	14	24	11	165	61	23.57	8.71	2.75
Tennessee	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	3	---	.43	---
Utah	1	2	30	3	-	-	-	-	-	-	-	-	-	-	31	5	4.43	.71	6.20
Virginia	2	1	-	-	-	-	54	3	-	-	2	3	18	2	76	9	10.87	1.29	8.44
Washington	-	-	17	2	-	2	-	-	2	1	-	2	-	-	19	7	2.71	1.00	2.71
West Virginia	36	7	23	5	11	4	11	7	9	5	8	4	5	4	103	36	14.57	5.14	2.86
Wisconsin	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	---	.14	---
Wyoming	-	-	-	-	-	-	-	-	-	-	-	-	3	1	3	1	.43	.14	3.00
Total	139	38	199	34	217	26	87	33	122	22	28	26	54	23	846	202	120.86	28.86	4.21

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CAUSES OF EXPLOSIONS

Table 3 lists causes of explosions in the United States during the past 7 fiscal years, as reported to the Safety Division of the United States Bureau of Mines. It will be noted that 202 explosions have been studied during the 7-year period, an average of approximately 28.8 a year. There were 23 explosions during the past fiscal year, 3 less than during the previous year and 5.8 less than the yearly average for the period. Eighty-three (41.1 percent) of these explosions (an average of 12 a year) during the 7-year period were of electrical origin; this source caused 43.5 percent of the explosions during the past fiscal year, a 5-percent increase over the preceding year and a 2-percent increase over the average for the 7-year period.

Table 3 shows that explosives were responsible for 8.7 percent of the explosions during the past fiscal year compared with 11.5 percent for the previous year and with an average of 16.9 percent for the 7-year period. Undoubtedly numerous explosions have been caused by explosives during the past 7 years in addition to the 34 listed in table 3, as many explosions originating from blasting which do not result in deaths or serious property damage may not come to the attention of the Safety Division personnel. The reduction in explosions from explosives may be attributed chiefly to safer practices in the handling of explosives and to the increased use of permissible explosives.

Open lights or smoking were responsible for 9 (39.1 percent) of the explosions occurring during the past fiscal year, the same number as in the previous year and slightly below the average for the 7-year period. Three of these explosions occurred when firebosses attempted to relight their safety lamps with matches; this practice has caused several disastrous explosions in past years. As it is impossible to control the actions of men completely key-locked safety lamps should be barred from every coal mine.

The cause of two of the explosions (8.7 percent of the total) was not ascertained. Both explosions listed under "unknown cause" were in anthracite mines; one resulted in 13 deaths and 50 injuries and the other in 3 deaths and 6 injuries; the first is believed to have been started by blasting.

EXPLOSION FATALITIES BY CAUSES

Table 4 compares explosion fatalities by causes and shows that during the past 7 fiscal years 846 fatalities occurred from explosions in mines of the United States, a yearly average of 120.8. The record of 1934, when 28 were killed by explosions, is by far the best of any one year in the mines of the United States since records have been available; the record of the fiscal year 1935, when 54 were killed, is the next best.

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TABLE 3. - Comparison of explosion - ignition causes, fiscal years 1929 to 1935, inclusive

Fiscal year	Ignition by electricity		Ignition by open lights or smoking		Ignition by explosives		Ignition by unknown causes		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
1929	18	47.4	11	29.0	8	21.0	1	2.6	38	100
1930	18	52.5	8	23.5	6	18.0	2	6.0	34	100
1931	9	34.6	11	42.3	6	23.1	-	.0	26	100
1932	10	30.1	15	45.5	5	15.2	3	9.2	33	100
1933	8	36.4	8	36.4	4	18.1	2	9.1	22	100
1934	10	38.5	9	34.6	3	11.5	4	15.4	26	100
1935	10	43.5	9	39.1	2	8.7	2	8.7	23	100
Total, 7 years	83		71		34		14		202	
Average, 7 years	11.8	41.1	10.1	35.1	4.9	16.9	2.0	6.9	28.8	100

TABLE 4. - Comparison of explosion fatalities by ignition causes, fiscal years 1929 to 1935, inclusive

Fiscal year	Electricity		Open lights or smoking		Explosives		Unknown		Total	
	Number killed	Percent	Number killed	Percent	Number killed	Percent	Number killed	Percent	Number killed	Percent
1929	93	66.9	14	10.1	26	18.7	6	4.3	139	100
1930	154	77.5	21	10.5	24	12.0	-	---	199	100
1931	143	65.9	56	25.8	18	8.3	-	---	217	100
1932	11	12.7	33	38.0	42	48.2	1	1.1	87	100
1933	25	20.5	63	51.6	29	23.8	5	4.1	122	100
1934	21	75.0	2	7.1	2	7.1	3	10.8	28	100
1935	29	53.7	6	11.0	3	5.6	16	29.7	54	100
Total, 7 years	476		195		144		31		846	
Average 7 years	68.0	56.3	27.6	23.0	20.7	17.0	4.4	3.7	120.8	100

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Explosions of electrical origin accounted for 56.3 percent of the deaths from explosions during the past 7 fiscal years; during the past year 53.7 of the fatalities from explosions - a little less than the average - were of electrical origin.

The fact that electricity continues to lead the list as a cause of explosions in mines evidences a disregard of the hazard from electric arcs in the presence of gas; there is good reason to believe that if rock-dusting had not been in effect the fatalities from explosions of such origin would be numerous.

Open lights or smoking caused explosions which resulted in 195 deaths during the past 7 fiscal years or 23 percent of the total fatalities from explosions during the period. During the past year 6 deaths (11 percent of the total) were attributed to this cause compared with 2 deaths in 1934. Five of the mine explosions caused by open lights or smoking during the year were in anthracite mines; two of the explosions occurred when men attempted to smoke in the presence of gas. Such carelessness shows the necessity of rigid discipline in this respect; anthracite mines are far more guilty of this breach of discipline and commonsense mine-safety precautions than bituminous mines.

During the past 7 years 144 deaths (17 percent of the total killed during this period from all causes) resulted from explosions caused by the misuse of explosives. Explosions caused by blasting have been reduced markedly during the past 2 years; only 5 deaths were reported during these 2 years compared with a yearly average of 20.7 deaths. One of the explosions caused by blasting during the fiscal year resulted from a "mud-cap" shot, and the other was thought to have resulted from careless handling of explosives. If one explosion with 13 fatalities, listed as of unknown origin but believed to have been caused by blasting, should be assessed against explosions caused by explosives the number would be 16 instead of 3 but it would still be lower than the 7-year average.

During the past 7 years 31 persons were killed in the mines of the United States in 14 explosions, the causes of which could not be ascertained by the Bureau of Mines Safety Division. It is often difficult to determine the cause of an explosion, because usually the persons involved are killed and the surrounding conditions are changed. During the past fiscal year 2 of the explosions resulting in 16 deaths were of unknown origin, both occurring in anthracite mines.

ELECTRICAL CAUSES OF EXPLOSIONS

Table 5 lists causes of explosions of electrical origin occurring in the United States during the past 7 fiscal years, insofar as data are available to the Safety Division of the Bureau of Mines. During the 7-year period there were 83 ignitions of electrical origin and during the past fiscal year, 10 ignitions with 29 fatalities. The greatest sources of electrical ignition in coal mines are trolley or cable-reel locomotives and nonpermissible mining

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machines; these two are responsible for approximately half of the electrical ignitions that occurred during the 7-year period. During the past fiscal year trolley or cable-reel locomotives accounted for the greatest number of ignitions, but nonpermissible electric drills accounted for the greatest number of deaths. Nonpermissible mining machines and nonpermissible electric pump motors were each responsible for two ignitions.

In most of the electrical ignitions there was evidence of carelessness in maintaining good ventilation or adequate rock-dusting in the sections in which the ignitions occurred. Other factors contributing to these electrical ignitions were: Failure to test for gas before going into working place with mining machine or drill; use of electrical equipment too soon after mine fan had been started; and use of haulageways as return airways.

COMPARISON OF LIGHTING IN MINES WHERE EXPLOSIONS OCCURRED

In a comparison of lighting in mines where explosions occurred during the past 7 fiscal years it is observed that of the 204 explosions listed 75 (36.8 percent of the total) occurred in open-light mines; that 119 (58.3 percent) were in closed-light mines; and that in 10 (4.9 percent) the lighting practice was unknown. The fact that the majority of these explosions occurred in closed-light mines indicates that far too much reliance is placed on closed-light equipment with either lack of appreciation of the hazards of inadequate ventilation, nonpermissible electrical equipment, and nonpermissible explosives or only a half-hearted attempt to control ignitions of gas or dust. No explosion was initiated by ignition of gas or dust by an electric cap lamp, though unquestionably some have been initiated by flame safety lamps either through use or misuse. Some coal-mining people are inclined to throw far too much burden on the well-established safety dependability of electric cap lamps and are using the fact that the electric cap lamp is safe equipment to cover the numerous unsafe features of nonpermissible electrical equipment, nonpermissible explosives, and defective or neglected ventilation.

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Cause	Number of electrical ignitions by fiscal years							Total, 7 years	Number killed		Number injured	
	1/ 1929	2/ 1930	3/ 1931	4/ 1932	5/ 1933	6/ 1934	1935		1934	1935	1934	1935
Trolley or cable-reel locomotive	7/ 5	5	1	1	4	5	3	7/ 23	13	1	4	4
Nonpermissible mining machine	8/ 5	5	3	3	1	-	2	8/ 18	—	4	-	4
Nonpermissible electric motor	4	3	-	-	-	-	2	9	—	2	-	-
Nonpermissible shotfiring battery or circuit	-	9 2	9 3	1	-	1	-	2	—	-	3	-
Cable nips or blow-outs	-	2	-	-	-	1	-	3	1	-	3	-
Nonpermissible electric drills	-	-	-	2	-	1	2	5	2	20	3	12
Nonpermissible storage-battery locomotives	1	1	2	-	-	-	-	4	—	-	-	-
Nonpermissible electric hoists	-	-	-	-	1	-	-	1	—	-	-	-
Faulty wiring	2	2	-	-	-	-	-	4	—	-	-	-
Trolley wire	1	-	2	1	-	-	-	4	—	-	-	-
Electric arc	2	-	1	2	1	2	1	9	5	2	7	-
Signal wire	-	-	-	-	1	-	-	1	-	-	-	-
Total ignitions	18	18	9	10	8	10	10	83	21	29	20	20

1/ See Inf. Circ. 6178. 2/ See Inf. Circ. 6419. 3/ See Inf. Circ. 6540. 4/ See Inf. Circ. 6680. 5/ See Inf. Circ. 6761. 6/ See Inf. Circ. 6819.
7/ 1 not included in totals; may have been open light, hence is assigned to open lights or smoking.
8/ 1 not included in totals; may have been from smoking, hence is assigned to open lights or smoking.
9/ Not included in totals; may have been from overcharged shots, hence is assigned to explosives accidents.

TABLE 6. - Comparison of lighting in mines where explosions occurred, fiscal years 1929 to 1935, inclusive

Fiscal year	Open lights		Closed lights		Lighting unknown		Total	
	Number of explosions	Per-cent	Number of explosions	Per-cent	Number of explosions	Per-cent	Number of explosions	Per-cent
1929	18	47.4	19	50.0	1	2.6	38	100
1930	8	23.5	25	73.5	1	3.0	34	100
1931	12	44.4	15	55.6	-	—	1/ 27	100
1932	15	44.1	15	44.1	4	11.8	1/ 34	100
1933	7	31.8	14	63.6	1	4.6	22	100
1934	9	34.6	14	53.9	3	11.5	26	100
1935	6	26.1	17	73.9	-	—	23	100
Total, 7 years	75	36.8	119	58.3	10	4.9	2/ 204	100

1/ 1 mine had mixed (open as well as closed) lighting.
2/ 2 mines had mixed (open as well as closed) lighting.

3)gz

MINE FIRES

Although mine fires, especially those in coal mines, are potential causes of great loss of life and tremendous property damage the mines of the United States have been fortunate during the past decade in that they have not experienced a fire that caused large loss of life; however, a number of fires have involved considerable property damage, and some mining companies persist in using methods or equipment that cause mine fires several times essentially every month throughout the year.

During the past fiscal year 26 mine fires were called to the attention of the United States Bureau of Mines Safety Division. No doubt, scores of other fires were detected and extinguished promptly without much damage or were handled quietly and more or less secretly by the mine involved; hence they were not made public.

Table 7 shows that Kentucky had the most fires in the fiscal year 1935; 6 fires were reported in that State during the year. Three fires each were reported in Colorado, Pennsylvania, and West Virginia; 2 in California; and 1 each in Alabama, Michigan, Ohio, Oklahoma, Tennessee, Utah, Virginia, Washington, and Wyoming. Five of these 26 fires were in metal mines. Electricity was responsible for 11 of the fires and 11 deaths; in 1 shaft fire 6 men were killed in an attempt to control the fire. Open lights started one of the fires in which hay was ignited in a mule barn. Of the 14 fires listed under miscellaneous 6 are of unknown origin; 4 probably were caused by spontaneous combustion; 1 was probably of incendiary origin; 1 was started by a forest fire which ignited drift timbers; 1 was caused by a lighted cigarette; and 1 was a fire that has been burning about 50 years and has covered an area of about 6 square miles. The total number of fires (26) during the fiscal year 1935 is above the average (22.8) for the preceding 5 years; also, the number of deaths (11) due to fires is an increase over the preceding 3 years.

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TABLE 7. - Summary of mine fires by States, July 1, 1930, to June 30, 1935

State	Lights				Fatalities by ignition causes								Total	
					Electricity		Open lights		Explosives		Miscellaneous			
	Open	Closed	Unknown	Total mine fires	Deaths	Ignitions	Deaths	Ignitions	Deaths	Ignitions	Deaths	Ignitions	Deaths	Ignitions
Alabama	-	1	-	1	-	1	-	-	-	-	-	-	-	1
California	2	-	-	2	-	-	-	1	-	-	-	1	-	2
Colorado	1	1	1	3	1	1	-	-	-	-	-	2	1	3
Kentucky	3	-	3	6	-	4	-	-	-	-	-	2	-	6
Michigan	-	-	1	1	1	1	-	-	-	-	-	-	1	1
Ohio	-	-	1	1	-	-	-	-	-	-	-	1	-	1
Oklahoma	-	-	1	1	1	1	-	-	-	-	-	-	1	1
Pennsylvania	-	-	3	3	-	-	-	-	-	-	-	3	-	3
Tennessee	-	-	1	1	-	-	-	-	-	-	-	1	-	1
Utah	-	-	1	1	-	-	-	-	-	-	-	1	-	1
Virginia	-	1	-	1	2	1	-	-	-	-	-	-	2	1
Washington	-	-	1	1	-	-	-	-	-	-	-	1	-	1
West Virginia	1	2	-	3	6	2	-	-	-	-	-	1	6	3
Wyoming	-	-	1	1	-	-	-	-	-	-	-	1	-	1
Total, 1935	7	5	14	26	11	11	-	1	-	-	-	2/14	11	1/26
Total, 1934 3/	10	5	3	18	-	4	-	-	5	5	1	9	6	18
Total, 1933 4/	12	6	9	27	-	7	-	-	-	2	2	18	2	27
Total, 1932 5/	8	5	8	21	1	8	-	-	-	3	-	10	1	21
Total, 1931 6/	12	7	5	24	-	7	5	3	-	5	18	9	23	24
Total, 1930 7/	7	8	9	24	2	9	3	6	-	3	-	6	5	24

1/ Includes 5 metal-mine fires and 4 outcrop fires.
2/ 4 of these fires were caused by spontaneous combustion.
3/ See Inf. Circ. 6819
4/ See Inf. Circ. 6761. 7/ See Inf. Circ. 6419.
5/ See Inf. Circ. 6680.
6/ See Inf. Circ. 6540.

Note. - This table includes data only on mine fires to which the attention of the Bureau of Mines Safety Division was called; mine fires are recorded by fiscal years.

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SUMMARY

It is encouraging to note that during the past 7 years the trend in the frequency and severity of explosions in the mines of this country has been definitely downward. Although the number of deaths from explosions during the fiscal year 1935 was nearly double that for 1934 (which was the best record in the history of coal mining in the United States) the record is still below the average for the 5 years preceding 1934; because of the numerous abnormal conditions and increased mining activities in a number of the important coal-producing States, some mining people feared that fires and explosions would be frequent, but fortunately that fear was not realized.

The years 1918, 1920, 1921, 1931, 1933, and 1934 have the best records as regards major fires and explosions in the mines of the United States; in the last year only 3 major disasters occurred, in all killing 36 men, and in the previous year (1933), only 1, killing 7 men. The material decline in frequency and severity of explosions and fires during the past 4 years is believed to be due primarily to: (1) Increased activities of the various State mine-inspection departments, especially in educational work and demand for more rigid adherence to State laws and safety practices far beyond the strict letter of the law; (2) the growing realization of the economic waste of all accidents, including explosions, and the more or less general acceptance of responsibility for accident occurrence by the mine operators; (3) the increased interest in accident prevention by the workers; and (4) the widespread dissemination of safety data by the United States Bureau of Mines and other safety organizations.

It is definitely known that mine explosions and fires can be prevented by the adoption of certain standard preventive measures, the expense of which is negligible compared with probable ultimate savings. The adoption of these preventive measures is largely a matter of the education of miners and operators to the seriousness of existing or potential hazards and a realization by the mine operators that most of these "accidents" can be prevented and that much of the burden rests squarely on their shoulders.

Table 8 presents data on major (those in which 5 or more lives were lost) coal-mine fire disasters in the United States since 1900. It is interesting to note that of the 24 major coal-mine fire disasters with a total of 552 fatalities since 1900, only 2 with 15 deaths have occurred since 1921 and that no major coal-mine fire disasters occurred in the United States during the period 1926-33, inclusive.

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TABLE 8. - Major coal-mine fires in the United States during the past 34 calendar years in which 5 or more were killed

Year	Number of fires	Killed
1901	2	36
1902	1	10
1903	0	-
1904	1	5
1905	3	19
	7	70
1906	1	8
1907	1	5
1908	2	38
1909	2	268
1910	1	10
	7	329
1911	1	72
1912	1	9
1913	0	-
1914	1	5
1915	0	-
	3	86
1916	0	-
1917	0	-
1918	1	13
1919	1	20
1920	1	6
	3	39
1921	2	13
1922	0	-
1923	0	-
1924	0	-
1925	1	9
	3	22
1926	0	-
1927	0	-
1928	0	-
1929	0	-
1930	0	-
	0	-
1931	0	-
1932	0	-
1933	0	-
1934	1	6
Grand total, 1901-34	1	6
	24	552

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Some of the salient points brought out in the study of mine explosions and fires in mines of the United States by the Safety Division of the United States Bureau of Mines for the year ended June 30, 1935 are as follows:

1. Twenty-three explosions were studied, 16 in bituminous mines and 7 in anthracite mines, compared with 26 for the previous year and a yearly average of 29.8 for the previous 6 fiscal years.

2. Explosions took 54 lives in the last fiscal year compared with 28 the previous fiscal year and an average of 132 for the previous 6 fiscal years. The 7 explosions in anthracite mines during the past year resulted in 18 deaths, whereas the 16 explosions occurring in bituminous mines resulted in 36 deaths.

3. The two major explosions during the fiscal year accounted for 30 deaths, while the 21 minor explosions accounted for 24 deaths; in 6 of the explosions no deaths resulted.

4. Six explosions occurred in open-light mines compared with 9 in 1934 and a yearly average of 11.5 for the previous 6 fiscal years. Seventeen explosions were in closed-light mines compared with 14 in 1934 and a yearly average of 17 for the previous 6 fiscal years; in three of the closed-light mines gas was ignited when firebosses attempted to relight their flame safety lamps with matches.

5. Ten explosions, causing 29 deaths, were of electrical origin compared with the same number of explosions and 21 deaths for the previous fiscal year. Explosions of electrical origin averaged 12.5 and deaths 74.5 annually for the previous 6 fiscal years. The past 4 fiscal years show a decided improvement in the occurrences of electrical explosions.

6. West Virginia, with 3 explosions, ranks first in the number of explosions caused by electricity during the year, and Virginia with 18 deaths ranks first in the number of deaths from this cause.

7. Trolley and cable-reel locomotives continue to be the greatest source of explosions of electrical origin, accounting for 3 of the electrical explosions and 1 death; nonpermissible electric drills caused 2 explosions and 20 deaths.

8. Open lights or smoking caused 9 explosions with 6 deaths, compared with 9 explosions and 2 deaths in the previous year and an average of 10.3 explosions and 31.5 deaths during the previous 6 fiscal years. Three of the explosions occurring during the fiscal year 1935 were charged to firebosses who attempted to relight flame safety lamps with matches.

9. Two explosions and 3 deaths were attributed definitely to misuse of explosives compared with 3 explosions and 2 deaths from this cause in 1934 and an average of 5.3 explosions and 23.5 deaths during the previous 6 years. The 3 deaths caused by explosives during the past year resulted from ignition of gas

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by a "mud-cap" shot; in one explosion, the cause of which is unknown, strong suspicion has been directed toward blasting.

10. Rock dust was used to some extent in at least 5 mines in which explosions occurred during the past year. In two of the mines in which explosions occurred rock dust is credited with stopping the spread of the explosions.

11. Twenty of the explosions during the past year are thought to have been initiated by gas and one by coal dust.

12. The underlying cause of at least 51 of the 54 deaths resulting from explosions during the past fiscal year was defective ventilation, manifest both in open- and closed-light mines.

13. The severity of explosions last year was reduced approximately 50 percent compared to the average for the preceding 6 years. The average number of deaths per explosion last year was 2.3 compared with an average of 4.4 deaths per explosion for the preceding 6 years.

14. During the fiscal year 1935, 26 mine fires with 11 deaths were reported compared with an average of 22.8 fires and 7.4 deaths per year for the preceding 5 years.

15. The 54 deaths from explosions during the fiscal year 1935 occurred in 8 States; 19 of the coal-producing States had no fatalities from this cause.

CONCLUSIONS

The data in this circular were compiled in the same manner as in previous years (see Inf. Circs. 6178, 6419, 6540, 6630, 6761, and 6819) and embody only facts revealed through studies by field employees of the United States Bureau of Mines Safety Division. Although an attempt is made to obtain information on every explosion that occurs in the United States some of the less destructive are not brought to the attention of the Bureau early enough to permit investigation; rarely, if ever, does the Bureau fail to acquire fairly complete details of mine explosions in which more than one life is lost or in which a considerable amount of property is damaged. The data in these publications are therefore relatively complete, especially those on explosions causing loss of more than one life. The data on fires are by no means as complete as those for explosions, and there is reason to believe that scores of fires in both coal and metal mines occur annually without the knowledge of the United States Bureau of Mines or even the State inspection forces. Mine fires occur almost daily in some coal mines, particularly at shot-firing time or where the coal fires spontaneously, and fires of electrical origin or from open lights are not unusual in metal mines.

A study of the data available on explosions and fires in the United States during the past 6 or 7 years reveals an encouraging reduction in the frequency and severity of these disasters.

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In the 20-year period preceding 1929 mine explosions and fires took an average toll of about 285 lives annually in the United States; since then the number of fatalities from explosions and fires has been reduced to an average of 128. The fiscal year 1934 established an all-time low record - only 34 fatalities resulted from explosions and fires compared with 65 in the fiscal year 1935. There is no good reason why the good record of 1934 cannot be equaled every year; in any year in which the record is not better than in the fiscal year 1934 certainly negligence has been the cause. Mine explosions and fires are preventable and most certainly should be prevented.

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